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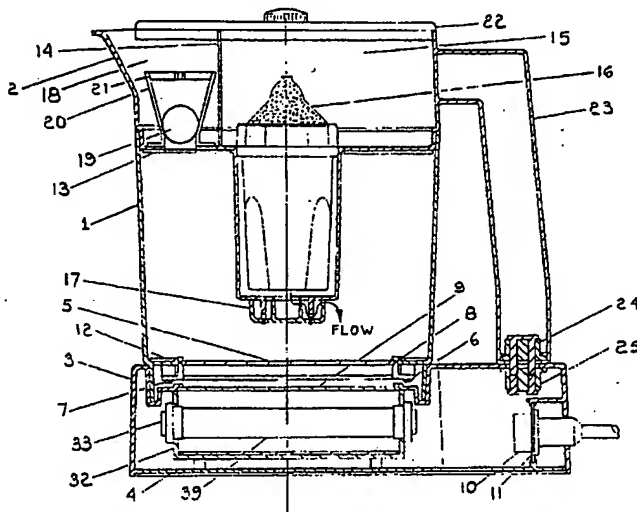
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(54) Title: TREATMENT APPARATUS FOR IMPROVING THE QUALITY OF DRINKING WATER BY FILTRATION AND DISINFECTION



(57) Abstract

A water jug in two sections (1 and 2), the two halves being separable by the user for internal cleaning, houses a replaceable filter cartridge (16) and engages with a free standing base unit (3), having an ultraviolet lamp (39) and associated electrical circuits and components. An aperture (9) in the base unit and matching ultraviolet transparent window (5) in the lower section (1) of the jug facilitate the transmission of ultraviolet light from the base unit into the jug. Disabling means (24 and 25) located between the jug and the base unit prevents the lamp being energised when the jug is separated from the base unit. Obscuration means (20, 17, 6) prevent ultraviolet light from escaping from the pouring spout (18), from the filter housing, when the filter (16) is removed, or from the interface between the jug (1) and the base unit (3) whilst allowing free flow of water commensurate with correct operation of the system.

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TREATMENT APPARATUS  
FOR IMPROVING THE QUALITY OF DRINKING WATER  
BY FILTRATION AND DISINFECTION

This invention relates to treatment apparatus for improving the quality of  
5 drinking water by filtration and disinfection.

Water filters are becoming common domestic appliances used for filtering  
tap water prior to drinking. The function of the filter is primarily to remove  
pollutants which may be harmful to health and to improve the taste of the  
water. Typical pollutants include nitrates, lead, aluminium, cadmium and  
10 zinc. By removing residual chlorine and other components, improved flavour  
can be achieved.

One problem with filters is that they do not protect against bacteria,  
viruses or other pathogenic organisms which could be present in the water;  
indeed it is also recognised that the continually damp environment inside the  
15 filter itself is a potential breeding ground for potentially harmful organisms.

In many parts of continental Europe and other areas of the world, bottled  
water is used extensively for drinking purposes, due to the inadequate or  
unreliable quality of domestic supplies, or simply concern on the part of the  
consumer.

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There are also a number of specific situations where extra precautions are advised even when the domestic supply is generally of high quality. Notably, all water given to babies either in drinks or in the form of pre-mixed feeds has to be boiled. This is inconvenient in terms of the time cycle required to  
5 boil and cool the water and is expensive in energy terms due to the high heat capacity of water.

Combined water filter / sterilizer units are available in a domestic form using the well known sterilizing effect of ultra violet light, but these are generally for plumbing into a domestic supply system or may be free  
10 standing, but incorporate a pump to pass the water through the device. These systems are relatively complex and as a result, too expensive to be adopted for widespread use in the domestic environment.

Using the principal of passing a flow of water past the ultra violet source they also suffer from limited contact time with the ultra violet thus requiring  
15 relatively high powered lamps and restriction of the water into a thin film (to reduce transmission losses of the ultra violet) requiring a pump to deliver the necessary pressure head to drive the water through the system.

Domestic water filters are commonly in the form of a jug where the water is treated in batches by filling a compartment and allowing the water to pass  
20 through the filter under the action of gravity.

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It is the aim of the present invention to provide an efficient combined water filter and ultra violet sterilizer for the batch treatment of drinking water which reduces the above mentioned problems and limitations.

Accordingly, the present invention provides treatment apparatus for  
5 improving the quality of drinking water by filtration and disinfection, which treatment apparatus comprises a free standing base unit housing an ultra violet lamp and the associated electrical circuits and components for the power supply and control of the lamp, the base unit having an aperture in its upper surface to facilitate the transmission of ultra violet light to a separate,  
10 removable water jug located temporarily on the base unit such water jug having an ultra violet transparent window to allow the passage of ultra violet into the jug and through water contained therein, such water having previously passed through a removable filter cartridge to extract impurities and improve clarity, and disabling means to prevent the lamp from being  
15 energised when the jug is separated from the base unit thus preventing accidental exposure of the user to ultra violet light.

The water jug may be divided into an upper and lower section with detachment means such that the two sections can be separated by the user for routine cleaning of the internals.

20 The disabling means may be arranged such that the lamp cannot be

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energised when either the complete water jug is separated from the base unit, or when the upper section of the water jug is separated from the lower section. This provides increased safety for the user.

5 The treatment apparatus may include location means such that in order to engage the water jug and the base unit together, thus enabling the lamp to be energised, the aperture in the base unit is caused to be correctly aligned with the ultra violet transparent window in the water jug and mating halves of the disabling means are correctly aligned for engagement.

10 The aperture in the base unit may be fitted with an ultra violet transparent cover to protect the lamp from accidental damage and water spillage when the water jug is separated from the base unit.

15 The base unit may contain mechanical protection means in the form of a shutter system, such shutter closing to cover the lamp when the water jug is removed from the base unit and opening to expose the lamp when the water jug is engaged with the base unit. In the open position the surfaces of the shutter may act as reflectors to direct ultra violet into the jug.

The water jug may include obscuration means such that ultra violet light cannot escape from the lower section of the jug to the surrounding environment either through the filter housing when the filter cartridge is

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removed (first obscuration means) or through the pouring spout when the jug is in a vertical position (second obscuration means). Such obscuration means will not impede the flow of the water between the sections of the jug commensurate with the requirements for correct functioning of the treatment apparatus.

The treatment apparatus may include third obscuration means such that ultra violet light is prevented from escaping into the surrounding environment from the interface between the water jug and the base unit.

The treatment apparatus may include a control circuit arranged such that power is supplied to the lamp for a pre-set period of time when the mating halves of the disabling means are engaged together.

The treatment apparatus may include a switch operating in conjunction with the disabling means such that power is supplied for a pre-set period of time to the lamp when the two halves of the disabling means are engaged together and the switch is closed.

The treatment apparatus may include indicator lights, indicating when power is connected to the base unit and / or when an operating cycle of the lamp has been completed.

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Embodiments of the invention will now be described solely by way of example and with reference to the accompanying drawings in which :

Fig 1. Shows a section of the complete assembly with the water jug located on the base unit in a vertical plane passing through the longitudinal axis of the ultra violet lamp.

Fig 2. Is a schematic diagram of the ultra violet lamp power supply circuit, showing the way in which the disabling means identified in Fig 1. is integrated into the circuit.

Fig 3. Is a section in a vertical plane taken at right angles to the longitudinal axis of the ultra violet lamp showing the lamp reflector means.

Fig 4. Is a modified version of Fig 3. showing an alternative disabling means arrangement in which power to the lamp is interrupted only when the complete water jug or the lower section thereof is separated from the base unit.

Fig 5. Is a modified version of Fig 1. showing the general arrangement when the alternative disabling means shown in Fig 4. is adopted.



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- Fig 6. Shows the second obscuration means situated in the spout of the water jug in pouring mode, allowing free flow of water.
- Fig 7. Is a modified version of Fig 3. showing mechanical protection means in the form of a shutter system. The shutter is shown in the open position.
- Fig 8. Shows a section in the horizontal plane taken just above the aperture in the base unit showing a location means incorporated into the 'skirt' at the base of the jug (third obscuration means).
- Fig 9. Shows a side view of the water jug showing a detachment means for separating the upper and lower sections.

Referring now to Fig 1. of the drawings, the treatment apparatus comprises a water jug divided into a lower section 1 and upper section 2 and a base unit 3 with cover plate 4. These components would probably all be produced by injection moulding in plastic materials opaque to ultra violet light at the wavelengths concerned or alternatively in drawn or pressed metal. Ultra violet light is thus prevented from passing through the walls of the components into the surrounding environment. The lower section of the water jug has an extended 'skirt' which locates into a matching recess on the upper surface of the base unit. The close 'nesting' of the jug and the

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base unit at this interface coupled with the fact that the rim of the skirt of the jug rests on the surface of the base unit prevents ultra violet light from escaping from the void between the aperture in the base unit and the ultra violet transparent window 5 in the base of the water jug. The window would  
5 be made of quartz or possibly a PTFE copolymer having a high transmittance value for ultra violet at the 254 n m wavelength produced by the lamp 39 which is of the low pressure mercury vapour type. The window is retained by the retaining frame 6 and screws 7 which compress the water-tight seal 8. The aperture in the base unit is covered by an ultra violet  
10 transparent window 9 which could be bonded or clipped into place to provide a protective cover for the lamp, guarding against impact or water spillage when the jug is separated from the base unit. A standard electrical connector is provided to supply mains power for the lamp.

The captive half of the connector 10 is mounted on a plate 11, trapped  
15 between guide ribs on the base units 3 and the cover plate 4. The other half is removable and is part of a mains leads assembly with a domestic electrical plug at the other end.

A reflector plate 12, made of aluminium or other material having a high reflectance to ultra violet, is positioned in the lower section of the water jug.  
20 The reflector plate has a central aperture which fits around the boundary of the ultra violet transparent window. The plate may typically be bonded or

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clipped into place. A second reflector plate 13 is attached to the underside of the upper section of the water jug 2. Ultra violet light entering the jug through the ultra violet transparent window 5 is thus successively reflected between the lower plate 12 and the upper plate 13, each time passing again  
5 through water contained in the lower section of the jug 1.

The reflectors increase the germicidal effectiveness of the system by making maximum use of the available ultra violet energy.

The upper section of the water jug 2 is divided into two separate  
10 compartments by a moulded internal baffle 14. The main compartment 15 is filled with a quantity of water to be treated which then passes, under the action of gravity, through a replaceable filter cartridge 16. The cartridge may contain fine porous media, activated carbon and other constituents to remove suspended solids and impurities from the water. Filtered water then  
15 follows the path indicated by the arrow marked 'FLOW' and passes into the lower section of the jug 1 where is it exposed to ultra violet light. Circular ribs moulded into the base of the filter housing in the upper section of the jug, interlock with similar ribs on a obscuration cover 17, heat staked or clipped to the base of the filter housing. The interlocking ribs form a  
20 labyrinth path which allows the flow of water but blocks the path of ultra violet light by presenting no direct path for the transmission of light, resulting in the dissipation of energy as the light impinges on the various internal

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faces presented by the tortuous route. The filter cartridge 16 is periodically removed and replaced, and the labyrinth system described prevents accidental exposure of the user to ultra violet if the lamp were energised with the filter removed. The second compartment of the upper section of the

5 jug 2 is pouring spout 18. A ball valve is fitted in the throat of the spout in the form of a ball 19 and internally tapered ball housing 20. A radially ribbed retaining ring 21 is fitted to the ball housing 20 by adhesive bonding or ultrasonic welding. The complete ball valve assembly is similarly welded or bonded into position in the pouring spout 18. When the water jug is

10 engaged with the base unit such that the lamp can be energised, the essentially vertical orientation of the jug causes the ball 19 to seat in the tapered throat of the ball housing 20 such that ultra violet light cannot escape from the lower section of jug 2. A further significance of the ball valve is that the user is prevented from incorrectly filling the device through

15 the pouring spout 18 as opposed to the primary compartment 15 which would have the effect of by-passing the filtration stage of the process. A removable lid 22 is provided to cover the two compartments 15 and 18 of the upper section of the jug 2 except for a contoured cut out above the pouring spout such that water can be poured freely from the lower section of

20 the jug 1 by inclining to a suitable angle (refer also to Fig 6.).

The upper section of the water jug 2 incorporates an integral carrying handle 23. The carrying handle 23 houses one half of a two pin mateable

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electrical connector 24 with the pins shorted together. When the water jug is engaged with the base unit the electrically shorted connector half engages with the mating half 25 to complete the lamp power supply circuit. In this way the lamp power supply circuit is disabled when either (a) the complete  
5 water jug is separated from the base unit or (b) the upper section of the water jug 2 is separated from the lower section 1.

Referring now to Fig 2. the two halves of the mateable connector 24 and 25 are installed in the live side of the mains power supply such that when the two halves are engaged, power is supplied to the lamp control circuit 26,  
10 and when separated the power supply is broken. Alternatively, as indicated, the pins of connector half 24 may not be directly shorted together, but instead be wired to a switch 27 located in the handle such that power is supplied to the lamp control circuit 26 when the connector halves 24 and 25 are engaged and the switch 27 is closed by the user. An indicator lamp  
15 may be included in the handle such that a visible indication is given when the switch is closed and power supply circuit to the lamp is completed.

The lamp control circuit 26, contains a timer circuit such that power is supplied to the lamp for a pre-set period of time from the moment that power becomes available at the input terminals to the lamp control circuit 26. In  
20 the event that the power supply is interrupted during a cycle by either failure of the mains supply or premature separation of the water jug from the base

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unit or opening of the switch 27, the timer circuit is reset such that a new cycle is commenced when the power is re-instated at the input terminals to the lamp control circuit 26.

The remainder of the circuit for driving the lamp is a conventional inductive  
5 choke ballast 28, capacitor 29 and glow switch 30.

The lamp 39 is of the low pressure mercury vapour type which produces nearly all its output energy at a wavelength of 253.7 n m in the ultra violet band. This coincides with the optimum value for killing bacteria and other organisms and consequently this type of lamp is often referred to as  
10 germicidal. A lamp housing 32 supports the lamp which passes through an accurately toleranced hole in each end plate, there being a lamp connector 33 pressed onto the lamp terminal pins on the outside face of each end plate.

Referring now to Fig 3. The lamp and associated electrical circuits and  
15 components are attached to the cover plate 4 which is retained by screws 31 locating in threaded bosses in the base unit 3. The lamp housing 32 is contoured in a concave form surrounding the lamp. The surface of the lamp housing is reflective to ultra violet such that the energy is directed upwards through the aperture in the base unit. The concave form could be generally  
20 parabolic as shown, but the surface may include convex side walls since the

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objective is to achieve a wide angle of ultra violet leaving the aperture as opposed to a narrow, focused beam. The lamp housing 32 would probably be injection moulded plastic with a vacuum deposited metallic coating for the reflector surface.

- 5 Referring now to Fig 4., an alternative arrangement for disabling the lamp power supply as compared to that shown in Fig 1 is shown. In this case the connector half with short circuited pins 24 is mounted on the base of the water jug section 1 with the mating half 25 in the recessed surface of the base unit 3. In this case the lamp power supply is only disabled when the  
10 lower section of the water jug 1 is separated from the base unit.

Referring now to Fig 5., the carrying handle may be integral with the lower section of the water jug 1, when the disabling means described above and shown in Fig 4 is adopted.

- Referring now to Fig 6., the water jug is separated from the base unit and  
15 inclined by the user to pour treated water from the lower section of the jug 1 through the pouring spout 18. The ball 19 is moved away from its tapered seat by the water pressure head and is retained by the ball retainer 21 while the water flows around it.

Referring now to Fig 7., hinged flaps 33 are biased into a 'closed' position

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to cover the lamp when the water jug is separated from the base unit. The ultra violet transparent window 9 is not required to protect the lamp in this case thus reducing losses in the ultra violet energy which would otherwise occur by partial absorption, scattering and reflection at the window. The

5 flaps are moved to the 'open' position, exposing the lamp, when the water jug is located on the base unit, by ribs 34 projecting from the underside of the water jug, which pass through slots in the surface of the base unit to bear on each flap. The forces acting on the flaps due to the weight of the water jug bearing on them act about the hinge points to overcome the

10 closing forces exerted by the springs 42. The surfaces of the shutter reflect ultra violet into the water jug when open.

Referring now to Fig 8., a rib 35 projecting from the surface of the skirt at the base of the lower section of the water jug 1 engages with a matching recess in the base unit 3. The positioning of the rib and the recess on their

15 corresponding components is such that, when engaged, the aperture in the base unit is correctly aligned with the aperture in the water jug and the pins of the mateable connector halves 24 and 25 are aligned for correct engagement. The discontinuity formed in the skirt of the water jug 1 by the projecting rib 35 prevents engagement of the water jug 1 and the base unit 3

20 in any orientation other than the correct one.

Referring now to Fig 9., angled ribs 36 are moulded into the perimeter of



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the upper section of the water jug 2 at the interface with the lower section 1 such that they interlock with corresponding ribs 37 on the lower section.

The two sections 1 and 2 can be securely locked together by twisting them in opposite directions. Thus the user can readily separate the two sections

5 for routine cleaning of the internals. In two diametrically opposed positions the interlocking ribs may be replaced by a projection 40 aligned with the vertical axis of the jug on one section with a corresponding recess 41 moulded into the other section of the jug such that the two sections can only

be engaged with the handle in the correct orientation with respect to the

10 pouring spout and the ultra violet transparent window.

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CLAIMS :

1. Treatment apparatus for improving the quality of drinking water by filtering and disinfection, which treatment apparatus comprises a free standing base unit housing an ultra violet lamp and the associated electrical circuits and components for the power supply and control of the lamp, the base unit having an aperture in the upper surface to facilitate the transmission of ultra violet light to a separate, removable water jug located temporarily on the base unit, such water jug having an ultra violet transparent window to allow the passage of ultra violet light into water 10 contained in the jug, such water having previously passed through a removable filter cartridge to extract impurities and improve clarity, and disabling means to prevent the lamp from being energised when the jug is separated from the base unit to prevent accidental exposure of the user to ultra violet light.
2. Treatment apparatus as claimed in Claim 1 wherein the water jug comprises an upper and a lower section, the upper section being divided into two compartments, one to receive a quantity of water to be treated housing a replaceable filter cartridge and the other to facilitate pouring of the water from the jug on completion of a treatment cycle, the upper section being detachable from the lower section to facilitate cleaning of the internals with disabling means such that the ultra violet lamp cannot be energised when either the jug is

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separated from the base unit or the upper section of the jug is separated from the lower section.

3. Treatment apparatus as claimed in Claim 1 and Claim 2 having first obscuration means such that with the filter cartridge removed ultra violet light is prevented from escaping from the lower section of the jug whilst such obscuration means also permits the free flow of water between the upper and lower sections.
- 5
4. Treatment apparatus as claimed in any preceding claim wherein second obscuration means prevents the leakage of ultra violet light through the pouring spout from the lower section of the water jug when the jug is in a vertical position whilst such obscuration means allows the free flow of water from the lower section when the jug is tilted into a pouring position, whilst preventing flow in the reverse direction.
- 10
5. Treatment apparatus as claimed in any preceding claim wherein third obscuration means prevents the leakage of ultra violet light to the surrounding environment from the interface between the water jug and the base unit whilst such obscuration means also ensures correct alignment of the water jug and the base unit when the two are engaged together.
- 15
- 20

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6. Treatment apparatus as claimed in any preceding claim wherein the base unit contains reflector means which reflector means directs the ultra violet light emitted by the lamp upwards through the aperture in the base unit such reflector means also providing mechanical support for the lamp.
- 5
7. Treatment apparatus as claimed in any preceding claim wherein the water jug may contain reflector means in the form of reflective surfaces, one above the water level attached to the upper section of the jug and one on the inside surface at the base of the water jug, such that ultra violet light entering the lower section of the water jug is caused to pass through the water contained therein a number of times as the light is successively reflected from the upper to the lower surface and vice versa, the reflector at the base of the water jug having an aperture matching the ultra violet transparent window to facilitate entry of the ultra violet light into the jug.
- 10
- 15
8. Water treatment apparatus as claimed in any preceding claim wherein the base unit may be provided with protection means in the form of a shutter covering the lamp when the jug is separated from the base such shutter opening to expose the lamp when the jug is engaged on the base unit, the surfaces of the shutter reflecting ultra violet into the water jug when in the open position.
- 20

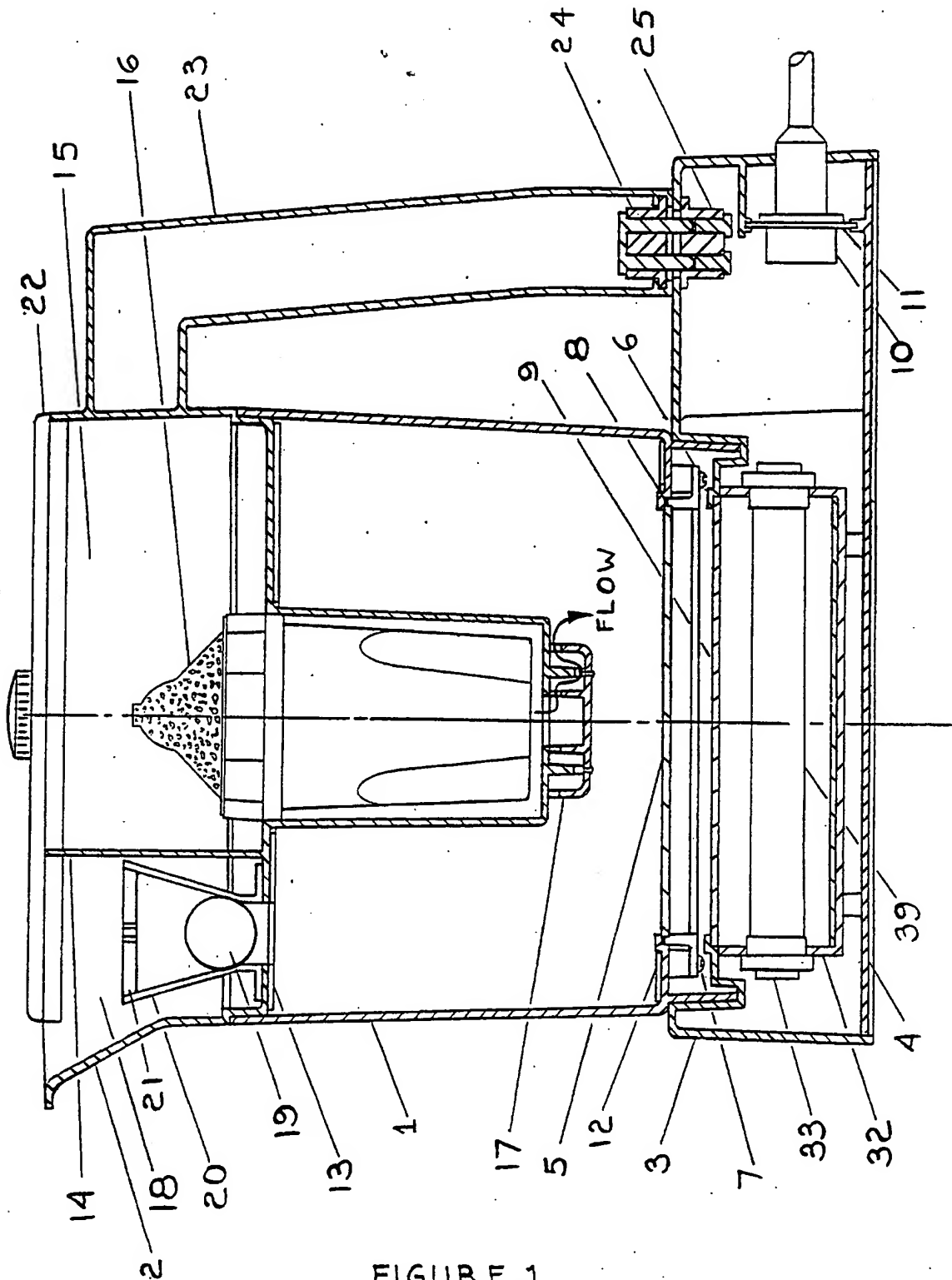


FIGURE 1

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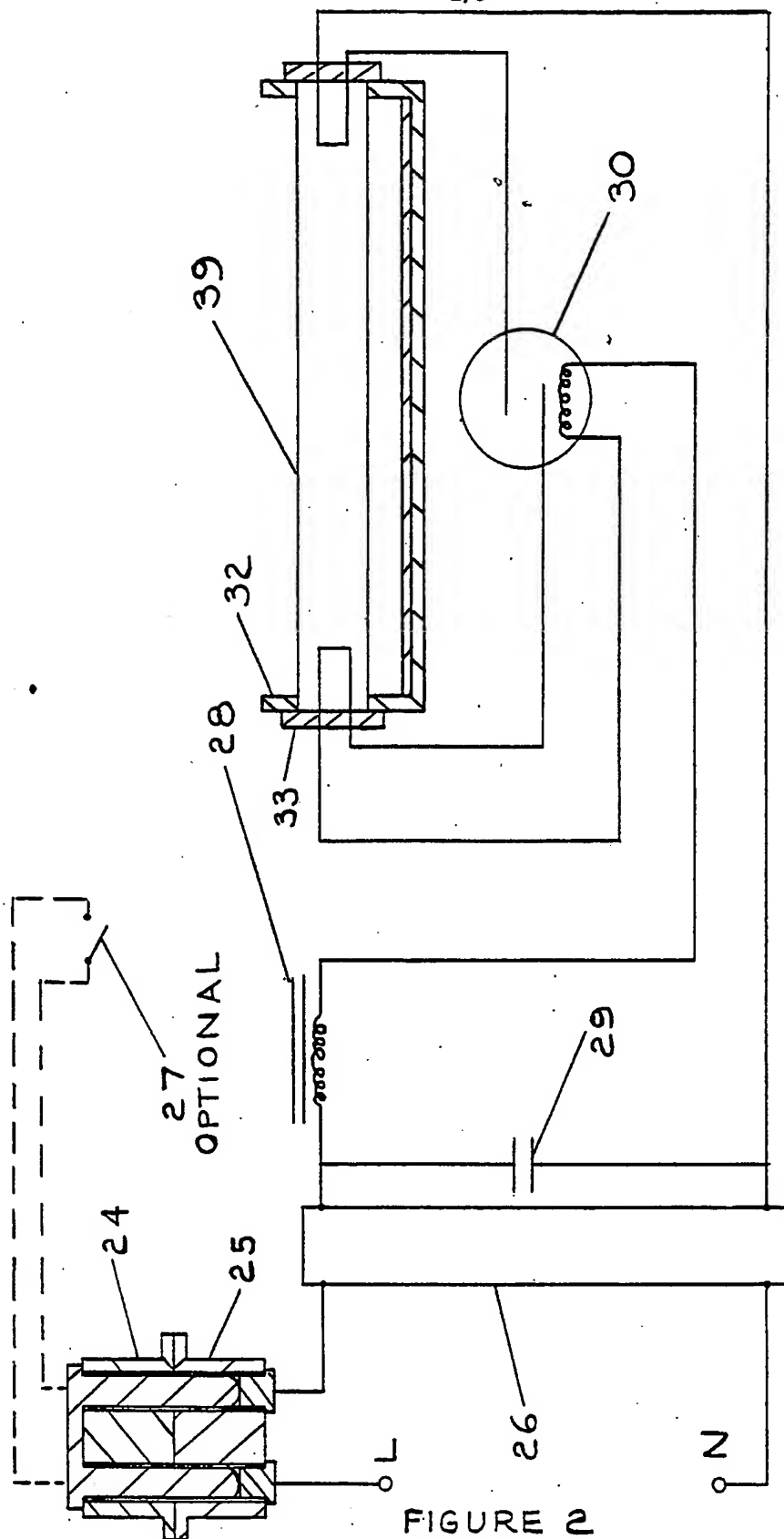


FIGURE 2

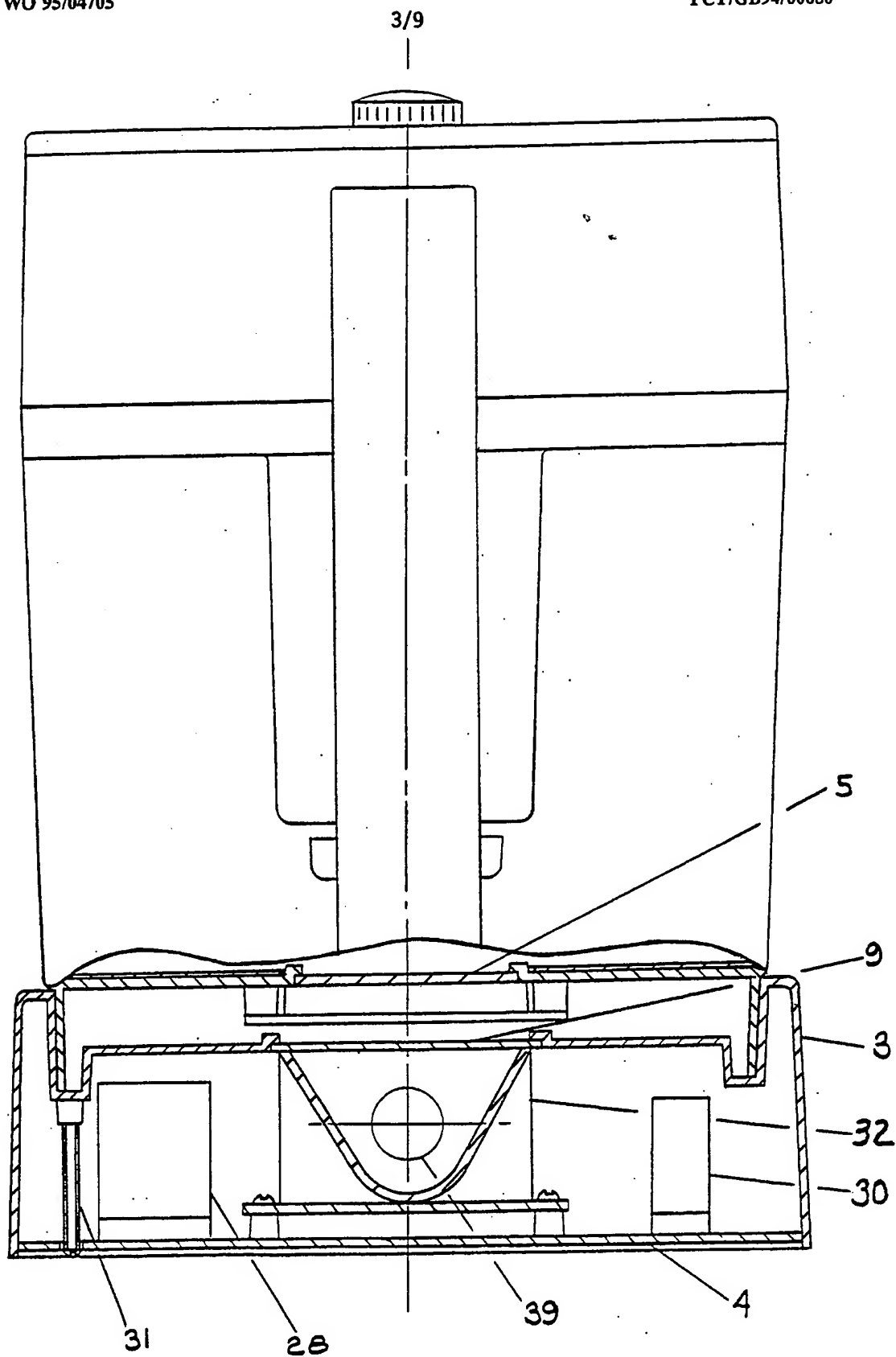


FIGURE 3

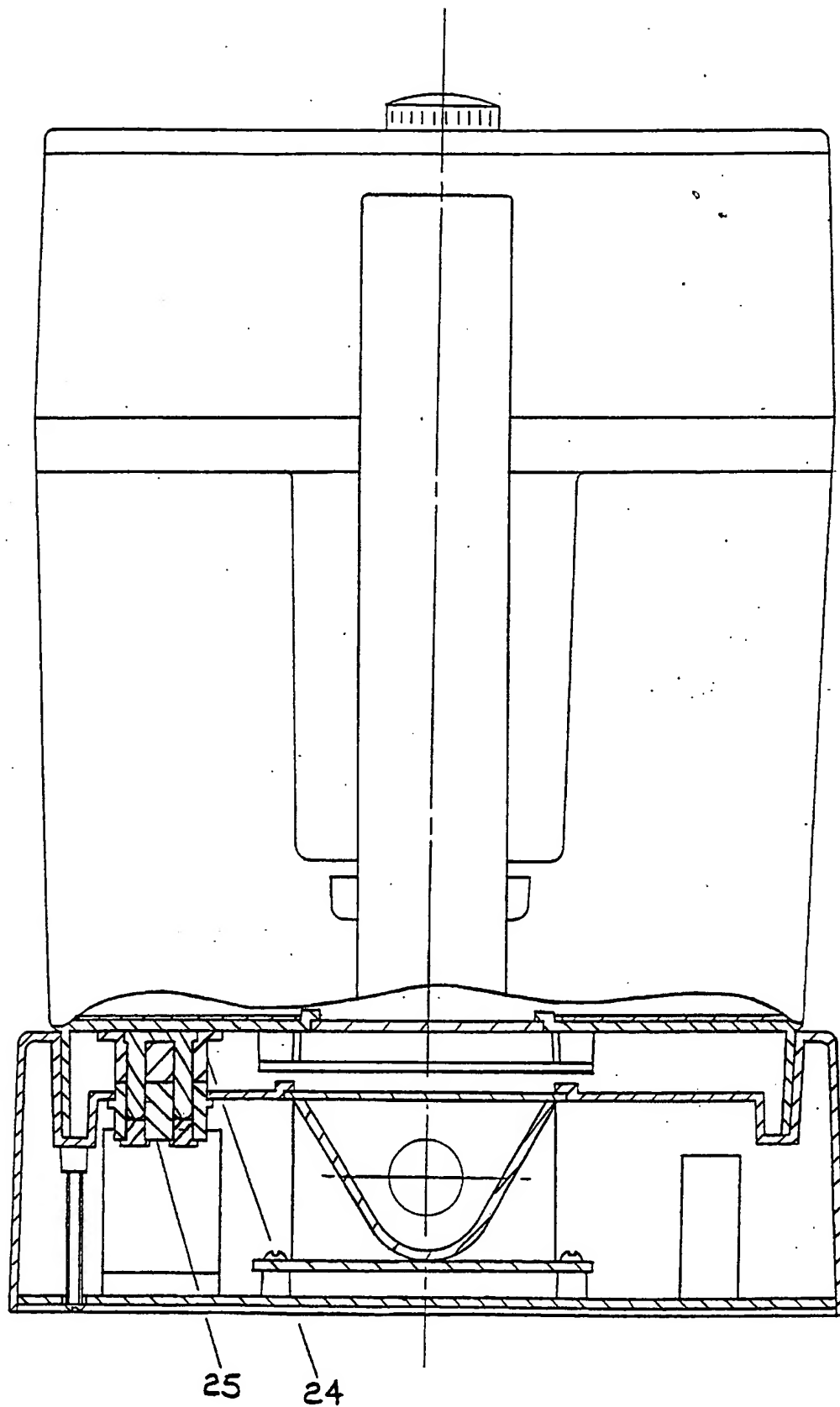


FIGURE 4



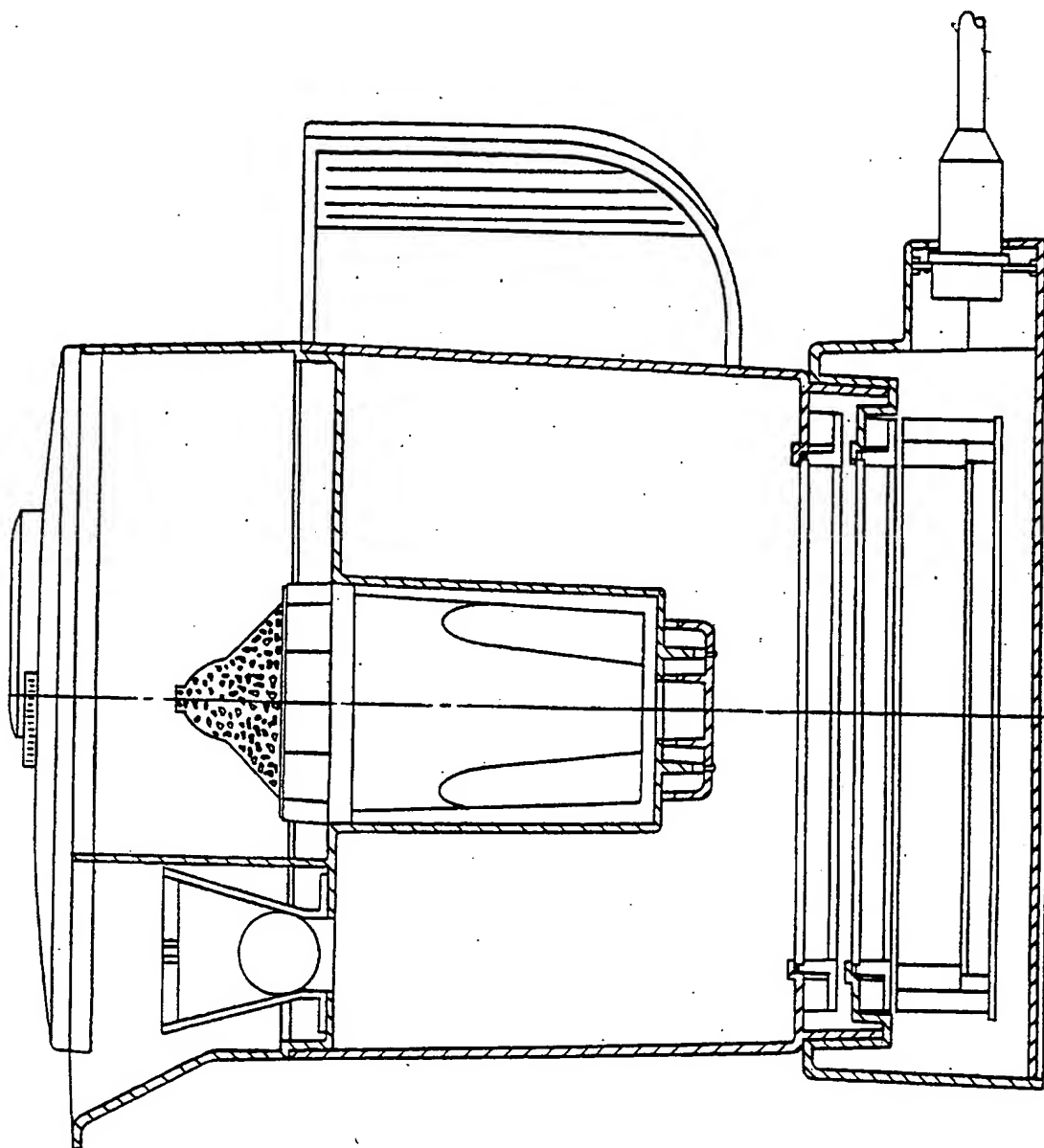


FIGURE 5

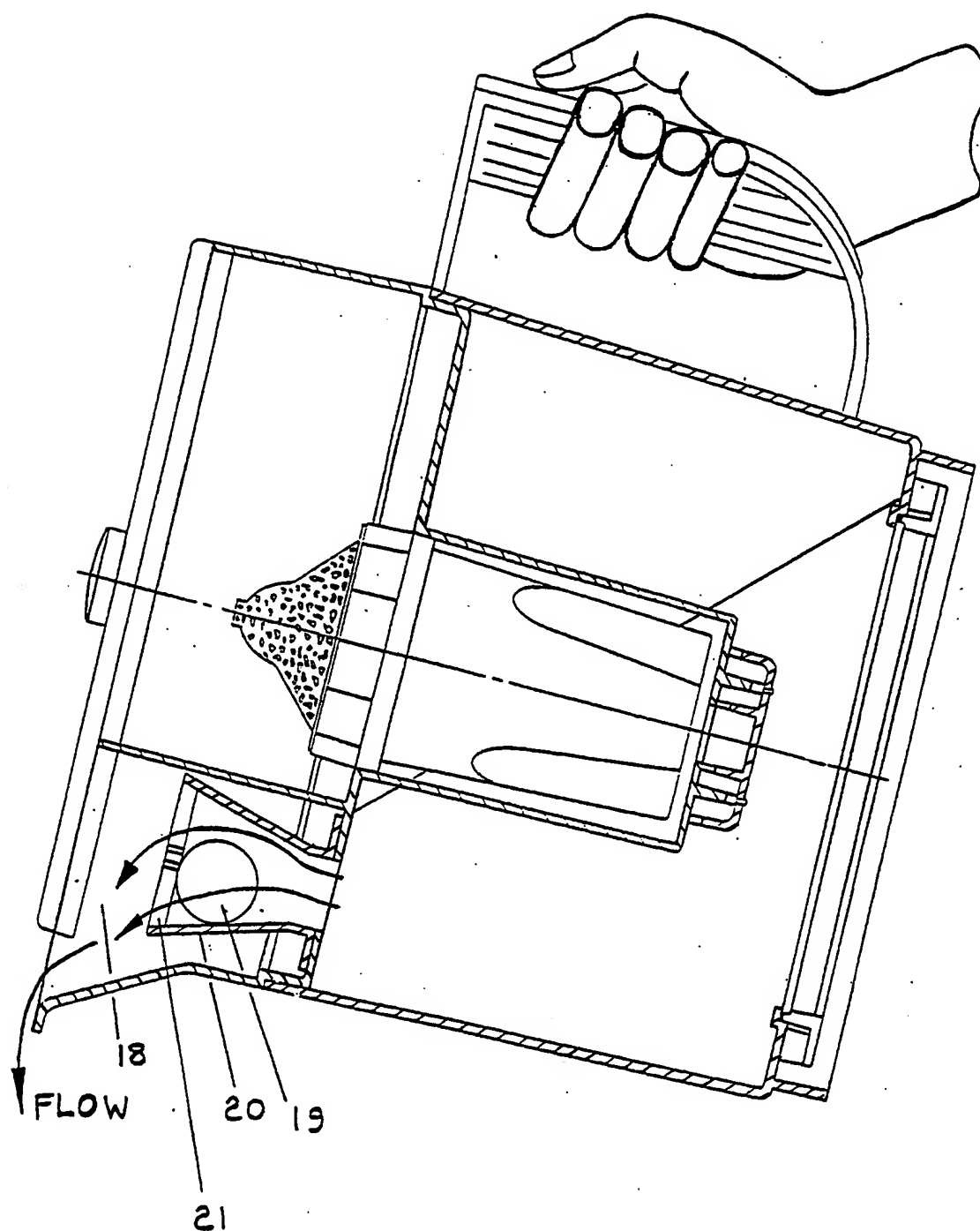
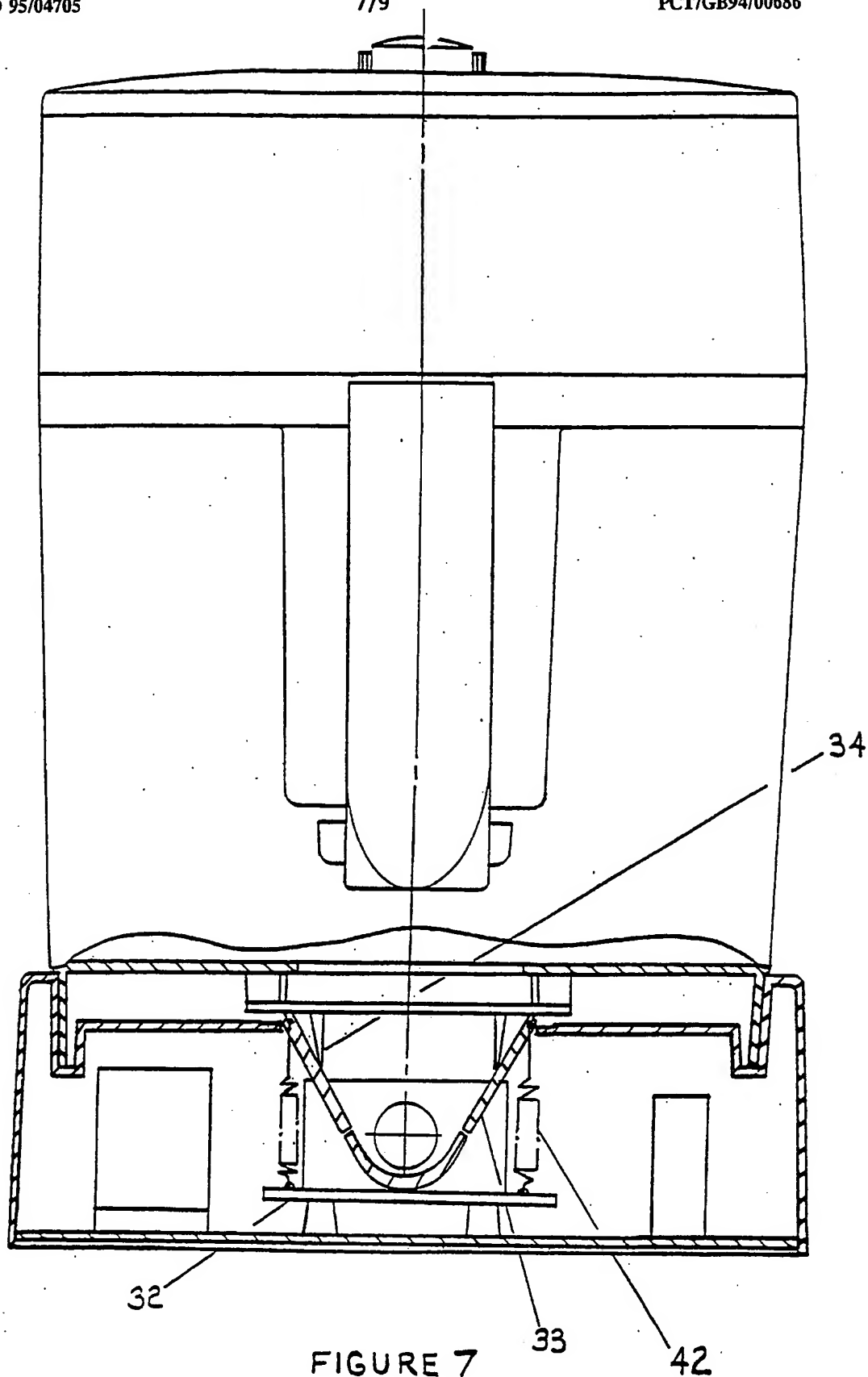


FIGURE 6



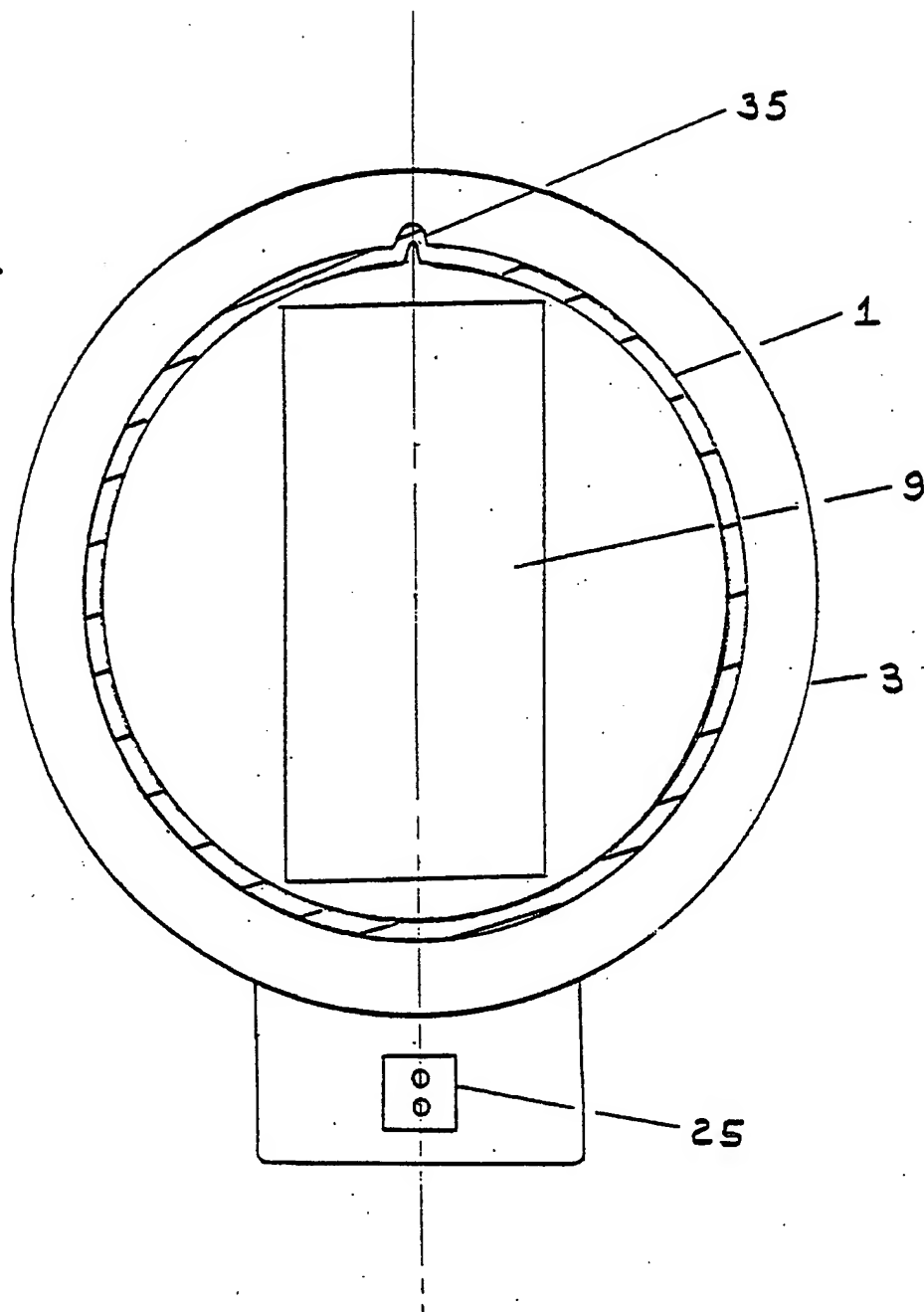


FIGURE 8

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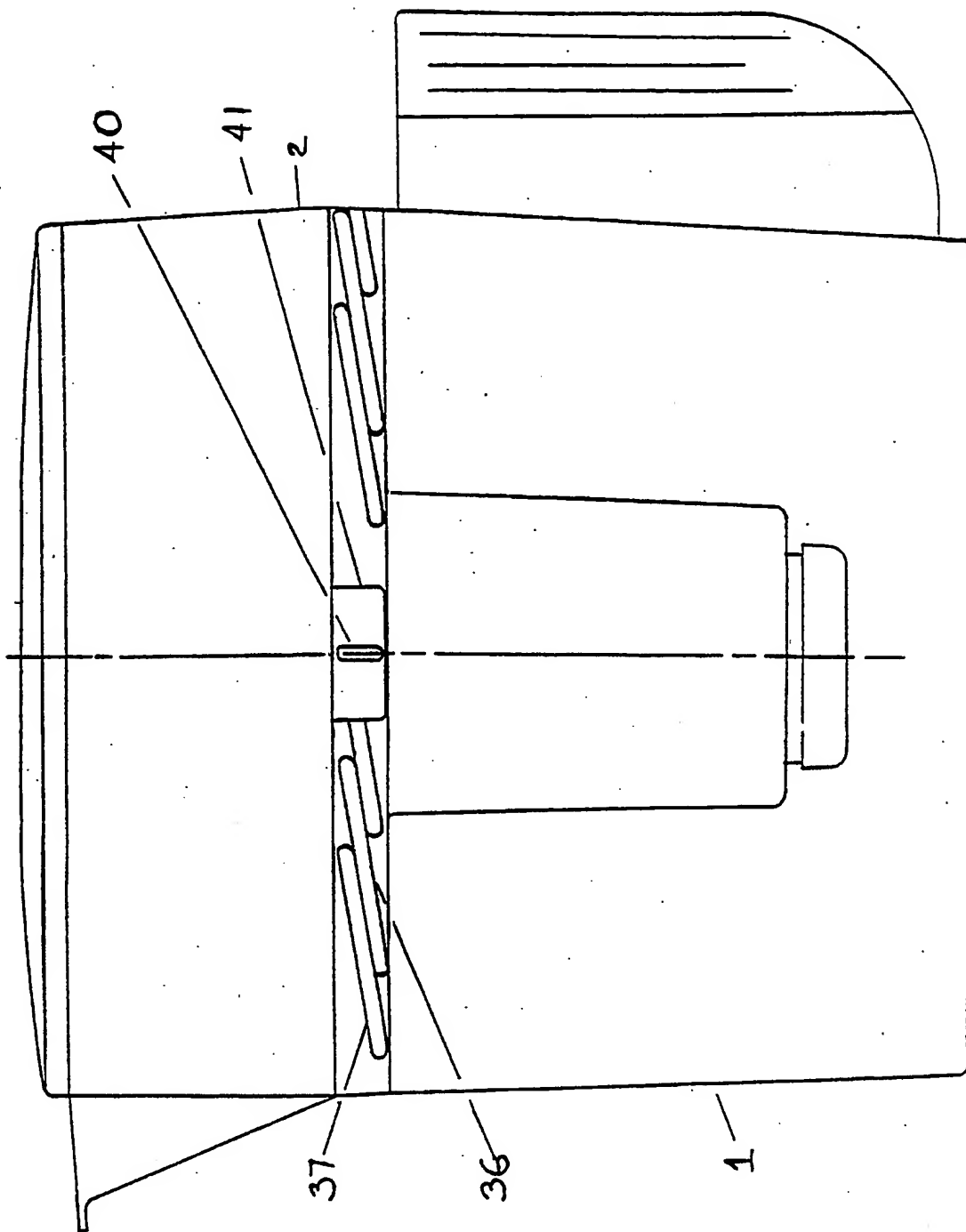


FIGURE 9

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB 94/00686A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 C02F1/32 C02F9/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 C02F A47J A47G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,5 227 053 (S.J. BRYM) 13 July 1993 see abstract; figures 1-3 ---	1
A	US,A,5 039 402 (W.D. HIMELSTEIN) 13 August 1991 see abstract; figures 1,2 ---	1
A	DE,A,38 40 276 (K.M. STAUSBERG) 31 May 1990 ---	
A	US,A,3 843 521 (J.D. ZEFF) 22 October 1974 -----	

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

31 August 1994

Date of mailing of the international search report

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Schmitt, J

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/GB 94/00686

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-5227053	13-07-93	NONE	
US-A-5039402	13-08-91	NONE	
DE-A-3840276	31-05-90	NONE	
US-A-3843521	22-10-74	NONE	

Legal status (INPADOC) of **WO9504705**

**WO F**                      **9400686 W**                      (Patent of invention)  
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**PRS Code :**              AL  
**Code Expl.:**            + DESIGNATED COUNTRIES FOR REGIONAL  
                             PATENTS  
**KD OF CORRESP. PAT.:** A1  
**DESIGNATED**  
**COUNTR.:**              AT BE CH DE DK ES FR GB GR IE IT LU MC NL PT SE

**PRS Date :** 1995/05/17  
**PRS Code :** 121  
**Code Expl.:** EP: THE EPO HAS BEEN INFORMED BY WIPO THAT EP WAS  
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**PRS Date :** 1996/05/15  
**PRS Code :** 122  
**Code Expl.:** - EP: PCT APP. NOT ENT. EUROP. PHASE